Diffraction, which forms the well-known coronas about the sun and moon, will for droplets of a certain size produce alternating red and blue rings to considerable angular distances from the luminary.[2] Recently I saw a solar corona with a set of four brilliant red rings at roughly equal intervals and interspersed with bluish rings. The larger the droplets, the smaller is the angular interval between successive rings of the same color and the smaller is the first ring around the sun or moon. Also, for any size of droplet, the angular interval between successive red rings decreases with increasing distance from the sun or moon. When the droplets are very small, as they must be in the lenticular clouds, the width of each red or blue ring is several degrees because the successive interference bands are so far apart. Thus an ordinary lenticular cloud may lie wholly within a red or blue band for very small drops. On the thin, sharp edge of the cloud where condensation has just taken place, the drops must be exceedingly small, and probably much the same size all along the edge around the cloud. For drops of this size at the distance of this cloud from the sun the diffraction band, say, is the third red one. Just inside of this cloud edge the particles have been formed for longer and have had a chance to grow to a larger size. For their size and this distance from the sun, the diffraction band, the fourth one (just beyond the third red), is blue. A little farther into the cloud the drops are still larger and are in the fourth red band for that size of drop. The central part of the cloud has still larger drops that fall in the fifth blue band. Therefore, the outer edge of the cloud has a rim of red, next comes a strip of blue and then another strip of red, while the central portion of the cloud is bluish and greenish.

The irregular intermixture of colors on the brilliant margin of a forming cumulus cloud may be explained on the same basis. The droplets just forming are not so large as those that have formed a few minutes before, and, therefore, while the angular distance from the sun may be such as to put this portion of the cloud in a red band for the droplets just formed, those a little larger even though they may be at the same angular distance from the sun are in the next blue or green band.

[2] See W. J. Humphreys, Optics of the Air, Jour. Franklin Inst., Nov., 1919, pp. 654-655.

MEASUREMENT OF WATER IN CLOUDS.

By L. F. RICHARDSON.

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Three types of clouds can be measured: I. Clouds into which an observer can enter. Several observers, notably Conrad and Wagner, have measured the water in clouds on mountains by drawing a measured volume of atmosphere over absorbing substances.[1] II. Clouds through which the sun's outline can be seen and which also exhibit coronae, as they often do. III. Uniform stratus, provided that some way can be found for measuring the size of the particles.

The second type of clouds has been investigated by means of a photometer which measures the variations of intensity of the sun's light in passing through cloud layers of different intensity. It has been suggested that the distance of visibility of an object through a mist is proportional to the diameter of the water particle. Conrad estimated that a terrestrial object was just visible when its intensity was about 1/77 that in clear air. This ratio of brightness of the object to its surroundings is represented by I/I_0. The observational results show that in various intensities of clouds through which the sun's disk could be seen, the volume of particles per horizontal area, the diameter of the particle, or $-2/3 \cos \zeta \log_e (I/I_0)$, is as follows; where ζ is the sun's zenith distance:

Description of cloud.	Volume of particles per horizontal area (diameter of particle).
Faintest cirrus	0.07.
Very thin cirrus	0.3, 0.3.
Ci or ci-stratus	0.04.
Very thin ci-stratus; Ci-stratus, thin; Ci-stratus (typical?)	0.06, 0.2, 0.8, 0.3, 0.5, 0.3, 0.8, 0.6, 0.4, 0.4, 0.8.
Ci-cumulus	0.6.
Ci-cumulus+ci-stratus	0.8, 0.9, 2.1.
Alto-cumulus	0.5.
Stratus, sun much dimmed, but still obvious at $\zeta=40°$.	2.5.
Stratus, sun's disk just visible at $\zeta=49°$	4.1.

It is pointed out that diffraction should be considered before this result can be relied upon.

In the case of heavier clouds, it is necessary to make use of the amount of transmitted light and the reflectivity of the earth's surface. In the case of certain rain clouds on the afternoon of May 24, 1918, it was found that the volume of liquid per horizontal cm.[2] of cloud amounted to 24 diameters of the cloud droplets. This, it will be noted, is in accord with the observations of thinner clouds in the table above.—*C. L. M.*

[1] The first type is discussed by Hann's Meteorology, third edition (1915), p. 306. The moisture was obtained by drawing known volumes of air over absorbing substances, such as calcium chloride or pumice stone saturated with sulphuric acid. It was found in this way that in various types of clouds on mountains the moisture content varied from 1.6 gram per cubic meter, where it was possible to see 50 meters through the cloud, to 4.5 gram per cubic meter where the radius of vision was limited to 20 or 25 meters. It was found that when the water particles are about 0.01 mm. in diameter, and the water-content of the cloud is from 1 to 2 grams per cubic meter, the number of drops is between 200 and 500 per cubic centimeter.—C. L. M.

SOME OBSERVATIONS ON A FREE-BALLOON FLIGHT MADE FROM ABERDEEN PROVING GROUND, MD., JUNE 3, 1920.

By DON MCNEAL, 2d Lieut. Meteorological Section, Signal Corps.

As a part of the course in pilots' training, a free balloon flight was made from Aberdeen Proving Ground, Md., June 3, 1920. Existing and indicated meteorological conditions on this day gave promise of anything but ideal weather for a flight of this kind. For three days preceding, this section of the country had watched the slow eastward drift of a trough of low pressure from the west and northwest, which had been attended by general rains and thunderstorms. On the morning of the 3d, the center of the trough extended from the St. Lawrence Valley southwestward over New York, Pennsylvania, West Virginia, Tennessee, and on to the Gulf.

The day opened fair, with only a few Ci.St. and A.Cu. clouds visible. These forms were moving from the west and southwest respectively. The pilot balloon observation, taken at 7:29 a. m., showed a west surface wind, veering quickly into WNW. and NW. winds, and above 8,500 feet, backing again into the west. The velocities were moderate at all levels, increasing only slightly with altitude.